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THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

ADDRESS OF THE PRESIDENT OF THE MATHEMATICAL AND PHYSICAL SECTION

IT is a great privilege and pleasure to address the members of this section on the occasion of the visit of the British Association to a country with which I have had such a long and pleasant connection. I feel myself in the presence of old friends, for the greater part of what may be called my scientific life has been spent in Canada, and I owe much to this country for the unusual facilities and opportunity for research so liberally provided by one of her great universities. Canada may well regard with pride her universities, which have made such liberal provision for teaching and research in pure and applied science. As a physicist, I may be allowed to refer in particular to the subject with which I am most intimately connected. After seeing the splendid home for physical science recently erected by the University of Toronto, and the older but no less serviceable and admirably equipped laboratories of McGill University, one can not but feel that Canada has recognized in a striking manner the great value attaching to teaching and research in physical science. In this, as in other branches of knowledge, Canada has made notable contributions in the past, and we may confidently anticipate that this is but an earnest of what will be accomplished in the future.

It is my intention to-day to say a few words upon the present position of the atomic theory in physical science, and to

[1] Winnipeg, 1909.

discuss briefly the various methods that have been devised to determine the values of certain fundamental atomic magnitudes. The present time seems very opportune for this purpose, for the rapid advance of physics during the last decade has not only given us a much clearer conception of the relation between electricity and matter and of the constitution of the atom, but has provided us with experimental methods of attack undreamt of a few years ago. At a time when, in the vision of the physicist, the atmosphere is dim with flying fragments of atoms, it may not be out of place to see how it has fared with the atoms themselves, and to look carefully at the atomic foundations on which the great superstructure of modern science has been raised. Every physicist and chemist can not but be aware of the great part the atomic hypothesis plays in science to-day. The idea that matter consists of a great number of small discrete particles forms practically the basis of the explanation of all properties of matter. As an indication of the importance of this theory in the advance of science it is of interest to read over the reports of this association and to note how many addresses, either wholly or in part, have been devoted to a consideration of this subject. Amongst numerous examples I may instance the famous and oft-quoted lecture of Maxwell on "Molecules," at Bradford in 1873; the discussion of the "Kinetic Theory of Gases" by Lord Kelvin, then Sir William Thomson, in Montreal in 1884; and the presidential address of Sir Arthur Rucker in 1901, which will be recalled by many here to-day.

It is far from my intention to discuss, except with extreme brevity, the gradual rise and development of the atomic theory. From the point of view of modern science, the atomic theory dates from the work of Dalton about 1805, who put it forward as an explanation of the combination of elements in definite proportions. The simplicity of this explanation of the facts of chemistry led to the rapid adoption of the atomic theory as a very convenient and valuable working hypothesis. By the labor of the chemists matter was shown to be composed of a number of elementary substances which could not be further decomposed by laboratory agencies, and the relative weights of the atoms of the elements were determined. On the physical side, the mathematical development of the kinetic or dynamical theory of gases by the labors of Clausius and Clerk Maxwell enormously extended the utility of this conception. It was shown that the properties of gases could be satisfactorily explained on the assumption that a gas consisted of a great assemblage of minute particles or molecules in continuous agitation, colliding with each other and with the walls of the containing vessel. Between encounters the molecules traveled in straight lines, and the free path of the molecules between collisions was supposed to be large compared with the linear dimensions of the molecules themselves. One can not but regard with admiration the remarkable success of this statistical theory in explaining the general properties of gases and even predicting unexpected relations. The strength and at the same time the limitations of the theory lie in the fact that it does not involve any definite conception of the nature of the molecules themselves or of the forces acting between them. The molecule, for example, may be considered as a perfectly elastic sphere or a Boscovitch center of force, as Lord Kelvin preferred to regard it, and yet on suitable assumptions the gas would show the same general statistical properties. We are consequently unable, without the aid of special subsidiary hypotheses, to draw conclusions of value in regard to the nature of the molecules themselves.

Towards the close of the last century the

ideas of the atomic theory had impregnated a very large part of the domain of physics and chemistry. The conception of atoms became more and more concrete. The atom in imagination was endowed with size and shape, and unconsciously in many cases with color. The simplicity and utility of atomic conceptions in explaining the most diverse phenomena of physics and chemistry naturally tended to enhance the importance of the theory in the eyes of the scientific worker. There was a tendency to regard the atomic theory as one of the established facts of nature, and not as a useful working hypothesis for which it was exceedingly difficult to obtain direct and convincing evidence. There were not wanting scientific men and philosophers to point out the uncertain foundations of the theory on which so much depended. Granting how useful molecular ideas were for the explanation of experimental facts, what evidence was there that the atoms were realities and not the figments of the imagination? It must be confessed that this lack of direct evidence did not in any way detract from the strength of the belief of the great majority of scientific men in the discreteness of matter. It was not unnatural, however, that there should be a reaction in some quarters against the domination of the atomic theory in physics and in chemistry. A school of thought arose that wished to do away with the atomic theory as the basis of explanation of chemistry, and substitute as its equivalent the law of combination in definite proportions. This movement was assisted by the possibility of explaining many chemical facts on the basis of thermodynamics without the aid of any hypothesis as to the particular structure of matter. Every one recognizes the great importance of such general methods of explanation, but the trouble is that few can think, or at any rate think correctly, in terms of thermodynamics. The negation of the atomic theory has not, and does not, help us to make new discoveries. The great advantage of the atomic theory is that it provides, so to speak, a tangible and concrete idea of matter which serves at once for the explanation of a multitude of facts and is of enormous aid as a working hypothesis. For the great majority of scientists it is not sufficient to group together a number of facts on general abstract principles. What is wanted is a concrete idea, however crude it may be, of the mechanism of the phenomena. This may be a weakness of the scientific mind, but it is one that deserves our sympathetic consideration. It represents an attitude of mind that appeals, I think, very strongly to the Anglo-Saxon temperament. It has no doubt as its basis the underlying idea that the facts of nature are ultimately explicable on general dynamical principles, and that there must consequently be some type of mechanism capable of accounting for the observed facts.

It has been generally considered that a decisive proof of the atomic structure of matter was in the nature of things impossible, and that the atomic theory must of necessity remain a hypothesis unverifiable by direct methods. Recent investigations have, however, disclosed such new and powerful methods of attack that we may well ask the question whether we do not now possess more decisive evidence of its truth.

Since molecules are invisible, it might appear, for example, an impossible hope that an experiment could be devised to show that the molecules of a fluid are in that state of continuous agitation which the kinetic theory leads us to suppose. In this connection I should like to draw your attention for a short time to a most striking phenomenon known as the "Brownian movement," which has been closely studied in recent years. Quite apart from its

probable explanation the phenomenon is of unusual interest. In 1827 the English botanist Brown observed by means of a microscope that minute particles like spores of plants introduced into a fluid were always in a state of continuous irregular agitation, dancing to and fro in all directions at considerable speeds. For a long time this effect, known as the Brownian movement, was ascribed to inequalities in the temperature of the solution. This was disproved by a number of subsequent investigations, and especially by those of Gouy, who showed that the movement was spontaneous and continuous and was exhibited by very small particles of whatever kind when immersed in a fluid medium. The velocity of agitation increased with decrease of diameter of the particles and increased with temperature, and was dependent on the viscosity of the surrounding fluid. With the advent of the ultra-microscope it has been possible to follow the movements with more certainty and to experiment with much smaller particles. Exner and Zsigmondy have determined the mean velocity of particles of known diameter in various solutions, while Svedberg has devised an ingenious method of determining the mean free path and the average velocity of particles of different diameter. The experiments of Ehrenhaft in 1907 showed that the Brownian movement was not confined to liquids, but was exhibited far more markedly by small particles suspended in gases. By passing an arc discharge between silver poles he produced a fine dust of silver in the air. When examined by means of the ultra-microscope the suspended particles exhibited the characteristic Brownian movement, with the difference that the mean free path for particles of the same size was much greater in gases than in liquids.

The particles exhibit in general the character of the motion which the kinetic theory ascribes to the molecules themselves, although even the smallest particles examined have a mass which is undoubtedly very large compared with that of the molecule. The character of the Brownian movement irresistibly impresses the observer with the idea that the particles are hurled hither and thither by the action of forces resident in the solution, and that these can only arise from the continuous and ceaseless movement of the invisible molecules of which the fluid is composed. Smoluchowski and Einstein have suggested explanations which are based on the kinetic theory, and there is a fair agreement between calculation and experiment. Strong additional confirmation of this view has been supplied by the very recent experiments of Perrin (1909). He obtained an emulsion of gamboge in water which consisted of a great number of spherical particles nearly of the same size, which showed the characteristic Brownian movement. The particles settled under gravity and when equilibrium was set up the distribution of these particles in layers at different heights was determined by counting the particles with a microscope. The number was found to diminish from the bottom of the vessel upwards according to an exponential law, *i. e.*, according to the same law as the pressure of the atmosphere diminishes from the surface of the earth. In this case, however, on account of the great mass of the particles, their distribution was confined to a region only a fraction of a millimeter deep. In a particular experiment the number of particles per unit volume decreased to half in a distance of 0.038 millimeter, while the corresponding distance in our atmosphere is about 6,000 meters. From measurements of the diameter and weight of each particle, Perrin found that, within the limit of experimental error, the law of distribution with height indicated that each small particle

had the same average kinetic energy of movement as the molecules of the solutions in which they were suspended; in fact, the particles in suspension behaved in all respects like molecules of very high molecular weight. This is a very important result, for it indicates that the law of equipartition of energy among molecules of different masses, which is an important deduction from the kinetic theory, holds, at any rate very approximately, for a distribution of particles in a medium whose masses and dimensions are exceedingly large compared with that of the molecules of the medium. Whatever may prove to be the exact explanation of this phenomenon, there can be little doubt that it results from the movement of the molecules of the solution and is thus a striking if somewhat indirect proof of the general correctness of the kinetic theory of matter.

From recent work in radioactivity we may take a second illustration which is novel and far more direct. It is well known that the α rays of radium are deflected by both magnetic and electric fields. It may be concluded from this evidence that the radiation is corpuscular in character, consisting of a stream of positively charged particles projected from the radium at a very high velocity. From the measurements of the deflection of the rays in passing through magnetic and electric fields the ratio e/m of the charge carried by the particle to its mass has been determined, and the magnitude of this quantity indicates that the particle is of atomic dimensions.

Rutherford and Geiger have recently developed a direct method of showing that this radiation is, as the other evidence indicated, discontinuous, and that it is possible to detect by a special electric method the passage of a single α particle into a suitable detecting vessel. The entrance of an α particle through a small opening was marked by a sudden movement of the needle of the electrometer which was used as a measuring instrument. In this way, by counting the number of separate impulses communicated to the electrometer needle, it was possible to determine by direct counting the number of α particles expelled per second from one gram of radium. But we can go further and confirm the result by counting the number of α particles by an entirely distinct method. Sir William Crookes has shown that when the α rays are allowed to fall upon a screen of phosphorescent zinc sulphide, a number of brilliant scintillations are observed. It appears as if the impact of each α particle produced a visible flash of light where it struck the screen. Using suitable screens the number of scintillations per second on a given area can be counted by means of a microscope. It has been shown that the number of scintillations determined in this way is equal to the number of impinging α particles when counted by the electric method. This shows that the impact of each α particle on the zinc sulphide produces a visible scintillation. There are thus two distinct methods—one electrical, the other optical—for detecting the emission of a single α particle from radium. The next question to consider is the nature of the α particle itself. The general evidence indicates that the α particle is a charged atom of helium, and this conclusion was decisively verified by Rutherford and Royds by showing that helium appeared in an exhausted space into which the α particles were fired. The helium, which is produced by radium, is due to the accumulated α particles which are so continuously expelled from it. If the rate of production of helium from radium is measured, we thus have a means of determining directly how many α particles are required to form a given volume of helium gas. This rate of production has recently been

measured accurately by Sir James Dewar. He has informed me that his final measurements show that one gram of radium in radioactive equilibrium produces 0.46 cubic millimeters of helium per day, or 5.32×10^{-6} cubic millimeters per second. Now from the direct counting experiments it is known that 13.6×10^{10} α particles are shot out per second from one gram of radium in equilibrium. Consequently it requires 2.56×10^{19} α particles to form one cubic centimeter of helium gas at standard pressure and temperature.

From other lines of evidence it is known that all the α particles from whatever source are identical in mass and constitution. It is not then unreasonable to suppose that the α particle, which exists as a separate entity in its flight, can exist also as a separate entity when the α particles are collected together to form a measurable volume of helium gas, or, in other words, that the α particle on losing its charge becomes the fundamental unit or atom of helium. In the case of a monatomic gas like helium, where the atom and molecule are believed to be identical, no difficulty of deduction arises from the possible combination of two or more atoms to form a complex molecule.

We consequently conclude from these experiments that one cubic centimeter of helium at standard pressure and temperature contains 2.56×10^{19} atoms. Knowing the density of helium, it at once follows that each atom of helium has a mass of 6.8×10^{-24} grams, and that the average distance apart of the molecules in the gaseous state at standard pressure and temperature is 3.4×10^{-7} centimeters.

The above result can be confirmed in a different way. It is known that the value of e/m for the α particle is 5,070 electromagnetic units. The positive charge carried by each α particle has been deduced by measuring the total charge carried by a counted number of α particles. Its value is 9.3×10^{-10} electrostatic units, or 3.1×10^{-20} electromagnetic units. Substituting this number in the value of e/m, it is seen that m, the mass of the α particle, is equal to 6.1×10^{-24} grams—a value in fair agreement with the number previously given.

I trust that my judgment is not prejudiced by the fact that I have taken some share in these investigations; but the experiments, taken as a whole, appear to me to give an almost direct and convincing proof of the atomic hypothesis of matter. By direct counting, the number of identical entities required to form a known volume of gas has been measured. May we not conclude that the gas is discrete in structure, and that this number represents the actual number of atoms in the gas?

We have seen that under special conditions it is possible to detect easily by an electrical method the emission of a single α particle—*i. e.*, of a single charged atom of matter. This has been rendered possible by the great velocity and energy of the expelled α particle, which confers on it the power of dissociating or ionizing the gas through which it passes. It is obviously only possible to detect the presence of a single atom of matter when it is endowed with some special property or properties which distinguishes it from the molecules of the gas with which it is surrounded. There is a very important and striking method, for example, of visibly differentiating between the ordinary molecules of a gas and the ions produced in the gas by various agencies. C. T. R. Wilson showed in 1897 that under certain conditions each charged ion became a center of condensation of water vapor, so that the presence of each ion was rendered visible to the eye. Sir Joseph Thomson, H. A. Wilson and others have employed this method to count the number of ions present

and to determine the magnitude of the electric charge carried by each.

A few examples will now be given which illustrate the older methods of estimating the mass and dimensions of molecules. As soon as the idea of the discrete structure of matter had taken firm hold, it was natural that attempts should be made to estimate the degree of coarse-grainedness of matter, and to form an idea of the dimension of molecules, assuming that they have extension in space. Lord Rayleigh has drawn attention to the fact that the earliest estimate of this kind was made by Thomas Young in 1805, from considerations of the theory of capillarity. Space does not allow me to consider the great variety of methods that have later been employed to form an idea of the thickness of a film of matter in which a molecular structure is discernible. This phase of the subject was always a favorite one with Lord Kelvin, who developed a number of important methods of estimating the probable dimensions of molecular structure.

The development of the kinetic theory of gases on a mathematical basis at once suggested methods of estimating the number of molecules in a cubic centimeter of any gas at normal pressure and temperature. This number, which will throughout be denoted by the symbol N, is a fundamental constant of gases; for, according to the hypothesis of Avogadro, and also on the kinetic theory, all gases at normal pressure and temperature have an identical number of molecules in unit volume. Knowing the value of N, approximate estimates can be made of the diameter of the molecule; but in our ignorance of the constitution of the molecule, the meaning of the term diameter is somewhat indefinite. It is usually considered to refer to the diameter of the sphere of action of the forces surrounding the molecule. This diameter is not necessarily the same for the molecules of all gases, so that it is preferable to consider the magnitude of the fundamental constant N. The earliest estimates based on the kinetic theory were made by Loschmidt, Johnstone Stoney and Maxwell. From the data then at his disposal, the latter found N to be 1.9×10^{19}. Meyer, in his "Kinetic Theory of Gases," discusses the various methods of estimating the dimensions of molecules on the theory, and concludes that the most probable estimate of N is 6.1×10^{19}. Estimates of N based on the kinetic theory are only approximate, and in many cases serve merely to fix an inferior or superior limit to the number of the molecules. Such estimates are, however, of considerable interest and historical importance, since for a long time they served as the most reliable methods of forming an idea of molecular magnitudes.

A very interesting and impressive method of determining the value of N was given by Lord Rayleigh in 1899 as a deduction from his theory of the blue color in the cloudless sky. This theory supposes that the molecules of the air scatter the waves of light incident upon them. This scattering for particles, small compared with the wave-length of light, is proportional to the fourth power of the wave-length, so that the proportion of scattered to incident light is much greater for the violet than for the red end of the spectrum, and consequently the sky which is viewed by the scattered light is of a deep blue color. This scattering of the light in passing through the atmosphere causes alterations of brightness of stars when viewed at different altitudes, and determinations of this loss of brightness have been made experimentally. Knowing this value, the number N of molecules in unit volume can be deduced by aid of the theory. From the data thus available, Lord Rayleigh concluded that the value of N was not less than 7×10^{18}. Lord Kelvin in 1902 recalculated the value

of N on the theory by using more recent and more accurate data, and found it to be 2.47×10^{19}. Since in the simple theory no account is taken of the additional scattering due to fine suspended particles which are undoubtedly present in the atmosphere, this method only serves to fix an inferior limit to the value of N. It is difficult to estimate with accuracy the correction to be applied for this effect, but it will be seen that the uncorrected number deduced by Lord Kelvin is not much smaller than the most probable value 2.77×10^{19} given later. Assuming the correctness of the theory and data employed, this would indicate that the scattering due to suspended particles in the atmosphere is only a small portion of the total scattering due to molecules of air. This is an interesting example of how an accurate knowledge of the value of N may possibly assist in forming an estimate of unknown magnitudes.

It is now necessary to consider some of the more recent and direct methods of estimating N which are based on recent additions to our scientific knowledge. The newer methods allow us to fix the value of N with much more certainty and precision than was possible a few years ago.

We have referred earlier in the paper to the investigations of Perrin on the law of distribution in a fluid of a great number of minute granules, and his proof that the granules behave like molecules of high molecular weight. The value of N can be deduced at once from the experimental results, and is found to be 3.14×10^{19}. The method developed by Perrin is a very novel and ingenious one, and is of great importance in throwing light on the law of equipartition of energy. This new method of attack of fundamental problems will no doubt be much further developed in the future.

It has already been shown that the value $N = 2.56 \times 10^{19}$ has been obtained by the direct method of counting the α particles and determining the corresponding volume of helium produced. Another very simple method of determining N from radioactive data is based on the rate of transformation of radium. Boltwood has shown by direct experiment that radium is half transformed in 2,000 years. From this it follows that initially in a gram of radium .346 milligram breaks up per year. Now it is known from the counting method that 3.4×10^{10} α particles are expelled per second from one gram of radium, and the evidence indicates that one α particle accompanies the disintegration of each atom. Consequently the number of α particles expelled per year is a measure of the number of atoms of radium present in .346 milligram. From this it follows that there are 3.1×10^{21} atoms in one gram of radium, and taking the atomic weight of radium as 226, it is simply deduced that the value of N is 3.1×10^{19}.

The study of the properties of ionized gases in recent years has led to the development of a number of important methods of determining the charge carried by the ion, produced in gases by α rays or the rays from radioactive substances. On modern views, electricity, like matter, is supposed to be discrete in structure, and the charge carried by the hydrogen atom set free by the electrolysis of water is taken as the fundamental unit of quantity of electricity. On this view, which is supported by strong evidence, the charge carried by the hydrogen atom is the smallest unit of electricity that can be obtained, and every quantity of electricity consists of an integral multiple of this unit. The experiments of Townsend have shown that the charge carried by a gaseous ion is, in the majority of cases, the same and equal in magnitude to the charge carried by a hydrogen atom in the electrolysis of water. From measurement of the quantity of electricity required to

set free one gram of hydrogen in electrolysis, it can be deduced that $Ne = 1.29 \times 10^{10}$ electrostatic units where N, as before, is the number of molecules of hydrogen in one cubic centimeter of gas, and e the charge carried by each ion. If e be determined experimentally, the value of N can at once be deduced from this relation.

The first direct measurement of the charge carried by the ion was made by Townsend in 1897. When a solution of sulphuric acid is electrolyzed, the liberated oxygen is found in a moist atmosphere to give rise to a dense cloud composed of minute globules of water. Each of these minute drops carries a negative charge of electricity. The size of the globules, and consequently the weight, was deduced with the aid of Stokes's formula by observing the rate of fall of the cloud under gravity. The weight of the cloud was measured, and, knowing the weight of each globule, the total number of drops present was determined. Since the total charge carried by the cloud was measured, the charge e carried by each drop was deduced. The value of e, the charge carried by each drop, was found by this method to be about 3.0×10^{-10} electrostatic units. The corresponding value of N is about 4.3×10^{19}.

We have already referred to the method discovered by C. T. R. Wilson of rendering each ion visible by the condensation of water upon it by a sudden expansion of the gas. The property was utilized by Sir Joseph Thomson to measure the charge e carried by each ion. When the expansion of the gas exceeds a certain value, the water condenses on both the negative and positive ions, and a dense cloud of small water drops is seen. J. J. Thomson found $e = 3.4 \times 10^{-10}$, H. A. Wilson $e = 3.1 \times 10^{-10}$, and Millikan and Begeman 4.06×10^{-10}. The corresponding values of N are 3.8, 4.2 and 3.2×10^{19} respectively. This method is of great interest and importance, as it provides a method of directly counting the number of ions produced in the gas. An exact determination of e by this method is, however, unfortunately beset with great experimental difficulties.

Moreau has recently measured the charge carried by the negative ions produced in flames. The values deduced for e and N were respectively 4.3×10^{-10} and 3.0×10^{19}.

We have referred earlier in the paper to the work of Ehrenhaft on the Brownian movement in air shown by ultra-microscopic dust of silver. In a recent paper (1909) he has shown that each of these particles carries a positive or negative charge. The size of each particle was measured by the ultra-microscope, and also by the rate of fall under gravity. The charge carried by each particle was deduced from the measured mass of the particle, and its rate of movement in an electric field. The mean value of e was found to be 4.6×10^{-10}, and thus N becomes 2.74×10^{19}.

A third important method of determination of N from radioactive data was given by Rutherford and Geiger in 1908. The charge carried by each α particle expelled from radium was measured by directly determining the total charge carried by a counted number of α particles. The value of the charge on each α particle was found to be 9.3×10^{-10}. From consideration of the general evidence, it was concluded that each α particle carries two unit positive charges, so that the value of e becomes 4.65×10^{-10}, and of N 2.77×10^{19}. This method is deserving of considerable confidence as the measurements involved are direct and capable of accuracy.

The methods of determination of e, so far explained, have depended on direct experiment. This discussion would not be complete without a reference to an important determination of e from theoretical considerations by Planck. From the

theory of the distribution of energy in the spectrum of a hot body, Planck found that $e = 4.69 \times 10^{-10}$, and $N = 2.80 \times 10^{19}$. For reasons that we can not enter into here, this theoretical deduction must be given great weight.

When we consider the great diversity of the theories and methods which have been utilized to determine the values of the atomic constants e and N, and the probable experimental errors, the agreement among the numbers is remarkably close. This is especially the case in considering the more recent measurements by very different methods, which are far more reliable than the older estimates. It is difficult to fix on one determination as more deserving of confidence than another; but I may be pardoned if I place some reliance on the radioactive method previously discussed, which depends on the charge carried by the α particle. The value obtained in this way is not only in close agreement with the theoretical estimate of Planck, but is in fair agreement with the recent determinations by several other distinct methods. We may consequently conclude that the number of molecules in a cubic centimeter of any gas at standard pressure and temperature is about 2.77×10^{19}, and that the value of the fundamental unit of quantity of electricity is about 4.65×10^{-10} electrostatic units. From these data it is a simple matter to deduce the mass of any atom whose atomic weight is known, and to determine the values of a number of related atomic and molecular magnitudes.

There is now no reason to view the values of these fundamental constants with scepticism, but they may be employed with confidence in calculations to advance still further our knowledge of the constitution of atoms and molecules. There will no doubt be a great number of investigations in the future to fix the values of these important constants with the greatest possible precision; but there is every reason to believe that the values are already known with reasonable certainty, and with a degree of accuracy far greater than it was possible to attain a few years ago. The remarkable agreement in the values of e and N, based on so many different theories, of itself affords exceedingly strong evidence of the correctness of the atomic theory of matter, and of electricity, for it is difficult to believe that such concordance would show itself if the atoms and their charges had no real existence.

There has been a tendency in some quarters to suppose that the development of physics in recent years has cast doubt on the validity of the atomic theory of matter. This view is quite erroneous, for it will be clear from the evidence already discussed that the recent discoveries have not only greatly strengthened the evidence in support of the theory, but have given an almost direct and convincing proof of its correctness. The chemical atom as a definite unit in the subdivision of matter is now fixed in an impregnable position in science. Leaving out of account considerations of etymology, the atom in chemistry has long been considered to refer only to the smallest unit of matter that enters into ordinary chemical combination. There is no assumption made that the atom itself is indestructible and eternal, or that methods may not ultimately be found for its subdivision into still more elementary units. The advent of the electron has shown that the atom is not the unit of smallest mass of which we have cognizance, while the study of radioactive bodies has shown that the atoms of a few elements of high atomic weight are not permanently stable, but break up spontaneously with the appearance of new types of matter. These advances in knowledge do not in any way invalidate the position of the chemical atom, but rather indicate its great impor-

tance as a subdivision of matter whose properties should be exhaustively studied.

The proof of the existence of corpuscles or electrons with an apparent mass very small compared with that of the hydrogen atom, marks an important stage in the extension of our ideas of atomic constitution. This discovery, which has exercised a profound influence on the development of modern physics, we owe mainly to the genius of the president of this association. The existence of the electron as a distinct entity is established by similar methods and with almost the same certainty as the existence of individual α particles. While it has not yet been found possible to detect a single electron by its electrical or optical effect, and thus to count the number directly as in the case of the α particles, there seems to be no reason why this should not be accomplished by the electric method. The effect to be anticipated for a single β particle is much smaller than that due to an α particle, but not too small for measurement. In this connection it is of interest to note that Regener has observed evidence of scintillations produced by the β particles of radium falling on a screen of platinocyanide of barium, but the scintillations are too feeble to count with certainty.

Experiment has shown that the apparent mass of the electron varies with its speed, and, by comparison of theory with experiment, it has been concluded that the mass of the electron is entirely electrical in origin and that there is no necessity to assume a material nucleus on which the electrical charge is distributed. While there can be no doubt that electrons can be released from the atom or molecule by a variety of agencies and, when in raipd motion, can retain an independent existence, there is still much room for discussion as to the actual constitution of electrons, if such a term may be employed, and of the part they play in atomic structure. There can be little doubt that the atom is a complex system, consisting of a number of positively and negatively charged masses which are held in equilibrium mainly by electrical forces; but it is difficult to assign the relative importance of the rôle played by the carriers of positive and negative electricity. While negative electricity can exist as a separate entity in the electron, there is yet no decisive proof of the existence of a corresponding positive electron. It is not known how much of the mass of an atom is due to electrons or other moving charges, or whether a type of mass quite distinct from electrical mass exists. Advance in this direction must be delayed until a clearer knowledge is gained of the character and structure of positive electricity and of its relation to the negative electron.

The general experimental evidence indicates that electrons play two distinct rôles in the structure of the atom, one as lightly attached and easily removable satellites or outliers of the atomic system, and the other as integral constituents of the interior structure of the atom. The former, which can be easily detached or set in vibration, probably play an important part in the combination of atoms to form molecules, and in the spectra of the elements; the latter, which are held in place by much stronger forces, can only be released as a result of an atomic explosion involving the disintegration of the atom. For example, the release of an electron with slow velocity by ordinary laboratory agencies does not appear to endanger the stability of the atom, but the expulsion of a high speed electron from a radioactive substance accompanies the transformation of the atom.

The idea that the atoms of the elements may be complex structures, made up either of lighter atoms or of the atoms of some fundamental substance, has long been fa-

miliar to science. So far no direct evidence has been obtained of the possibility of building up an atom of higher atomic weight from one of lower atomic weight, but in the case of the radioactive substances we have decisive and definite evidence that certain elements show the converse process of disintegration. It may be significant that this process has only been observed in the atoms of highest atomic weights, like those of uranium, thorium and radium. With the exception possibly of potassium, there is no reliable evidence that a similar process takes place in other elements. The transformation of the atom of a radioactive substance appears to result from an atomic explosion of great intensity in which a part of the atom is expelled with great speed. In the majority of cases, an α particle or atom of helium is ejected, in some cases a high-speed electron, while a few substances are transformed without the appearance of a detectable radiation. The fact that the α particles from a simple substance are all ejected with an identical and very high velocity suggests the probability that the charged helium atom before its expulsion is in rapid orbital movement in the atom. There is at present no definite evidence of the causes operative in these atomic transformations.

Since in a large number of cases the transformations of the atoms are accompanied by the expulsion of one or more charged atoms of helium, it is difficult to avoid the conclusion that the atoms of the radioactive elements are built up, in part at least, of helium atoms. It is certainly very remarkable and may prove of great significance, that helium, which is regarded from the ordinary chemical standpoint as an inert element, plays such an important part in the constitution of the atoms of uranium, thorium and radium.

The study of radioactivity has not only thrown great light on the character of atomic transformations, but it has also led to the development of methods for detecting the presence of almost infinitesimal quantities of radioactive matter. It has already been pointed out that two methods —one electrical, the other optical—have been devised for the detection of a single α particle. By the use of the optical or scintillation method, it is possible to count with accuracy the number of α particles when only one is expelled per minute. It is not a difficult matter, consequently, to follow the transformation of any radioactive substance in which only one atom breaks up per minute, provided that an α particle accompanies the transformation. In the case of a rapidly changing substance like the actinium emanation, which has a half period of 3.7 seconds, it is possible to detect with certainty the presence, if not of a single atom, at any rate of a few atoms, while the presence of a hundred atoms would in some cases give an inconveniently large effect. The counting of the scintillations affords an exceedingly powerful and direct quantitative method of studying the properties of radioactive substances which expel α particles. Not only is it a simple matter to count the number of α particles which are expelled in any given interval, but it is possible, for example, by suitably arranged experiments to decide whether one, two or more α particles are expelled at the disintegration of a single atom.

The possibility of detection of a single atom of matter has opened up a new field of investigation in the study of discontinuous phenomena. For example, the experimental law of transformation of radioactive matter expresses only the average rate of transformation, but by the aid of the scintillation or electric method it is possible to determine directly by experiment the actual interval between the disintegration of successive atoms and the probability

law of distribution of the α particles about the average value.

Quite apart from the importance of studying radioactive changes, the radiations from active bodies provide very valuable information as to the effects produced by high velocity particles in traversing matter. The three types of radiation, the α, β and γ rays, emitted from active bodies, differ widely in character and their power of penetration of matter. The α particles, for example, are completely stopped by a sheet of notepaper, while the γ rays from radium can be easily detected after traversing twenty centimeters of lead. The differences in the character of the absorption of the radiations are no doubt partly due to the difference in type of the radiation and partly due to the differences of velocity.

The character of the effects produced by the α and β particles is most simply studied in gases. The α particle has such great energy of motion that it plunges through the molecules of the gas in its path, and leaves in its train more than a hundred thousand ionized or dissociated molecules. After traversing a certain distance, the α particle suddenly loses its characteristic properties and vanishes from the ken of our observational methods. It no doubt quickly loses its high velocity, and after its charge has been neutralized becomes a wandering atom of helium. The ionization produced by the α particle appears to consist of the liberation of one or more slow velocity electrons from the molecule, but in the case of complex gases there is no doubt that the act of ionization is accompanied by a chemical dissociation of the molecule itself, although it is difficult to decide whether this dissociation is a primary or secondary effect. The chemical dissociation produced by α particles opens up a wide field of investigation, on which, so far, only a beginning has been made.

The β particle differs from the α particle in its much greater power of penetration of matter, and the very small number of molecules it ionizes compared with the α particle traversing the same path in the gas. It is very easily deflected from its path by encounters with the gas molecules, and there is strong evidence that, unlike the α particle, the β particle can be stopped or entrapped by a molecule when traveling at a very high speed.

When the great energy of motion of the α particle and the small amount of energy absorbed in ionizing a single molecule are taken into consideration, there appears to be no doubt that the α particle, as Bragg pointed out, actually passes through the atom, or rather the sphere of action of the atom which lies in its path. There is, so to speak, no time for the atom to get out of the way of the swiftly moving α particle, but the latter must pass through the atomic system. On this view, the old dictum, no doubt true in most cases, that two bodies can not occupy the same space, no longer holds for atoms of matter if moving at a sufficiently high speed.

There would appear to be little doubt that a careful study of the effects produced by the α or β particle in passing through matter will ultimately throw much further light on the constitution of the atom itself. Work already done shows that the character of the absorption of the radiations is intimately connected with the atomic weights of the elements and their position in the periodic table. One of the most striking effects of the passage of β rays through matter is the scattering of the β particles, *i. e.*, the deflection from their rectilinear path by their encounters with the molecules. It was for some time thought that such a scattering could not be expected to occur in the case of the α particles in consequence of their much greater mass and energy of motion. The

recent experiments of Geiger, however, show that the scattering of the α particles is very marked, and is so great that a small fraction of the α particles, which impinge on a screen of metal, have their velocity reversed in direction and emerge again on the same side. This scattering can be most conveniently studied by the method of scintillations. It can be shown that the deflection of the α particle from its path is quite perceptible after passing through very few atoms of matter. The conclusion is unavoidable that the atom is the seat of an intense electric field, for otherwise it would be impossible to change the direction of the particle in passing over such a minute distance as the diameter of a molecule.

In conclusion, I should like to emphasize the simplicity and directness of the methods of attack on atomic problems opened up by recent discoveries. As we have seen, not only is it a simple matter, for example, to count the number of α particles by the scintillations produced on a zinc sulphide screen, but it is possible to examine directly the deflection of an individual particle in passing through a magnetic or electric field, and to determine the deviation of each particle from a rectilinear path due to encounters with molecules of matter. We can determine directly the mass of each α particle, its charge, and its velocity, and can deduce at once the number of atoms present in a given weight of any known kind of matter. In the light of these and similar direct deductions, based on a minimum amount of assumption, the physicists have, I think, some justification for their faith that they are building on the solid rock of fact, and not, as we are often so solemnly warned by some of our scientific brethren, on the shifting sands of imaginative hypothesis.

E. Rutherford

THE HIGHEST BALLOON ASCENSION IN AMERICA

Although a large number of *ballons-sondes* were despatched from St. Louis in 1904–7 under the direction of the writer (see Science, Vol. 27, p. 315), none had been employed in the eastern states until last year. In May and July, 1908, four *ballons-sondes* were launched from Pittsfield, Mass., with special precautions to limit the time they remained in the air and so prevent them from drifting out to sea with the upper westerly wind. Three of the registering instruments have been returned to the Blue Hill Observatory with good records. The first instrument sent up on May 7 was not found for ten months and the record, forming the subject of the present article, is very interesting because it gives complete temperature data from the ground up to 17,700 meters, or 11 miles. This is 650 meters higher than the highest ascension from St. Louis, which, by a coincidence, was also the first one to be made there. On May 7 a general storm prevailed, so that the balloon, traveling from the east, was soon lost in the cloud and its subsequent drift could not be followed, but the resultant course was 59 miles from the southwest, as determined by the place where the instrument fell two hours later. At the ground the temperature was 4°.5 C., and this decreased as the balloon rose to the base of the cloud, which itself was considerably warmer than the underlying air. Above the cloud the temperature continued to fall with increasing rapidity up to a height of 12,500 meters (nearly eight miles) where the minimum of —54°.5 C. was registered. Here the great warm stratum was entered and penetrated farther than ever before in this country, namely, to the height of 17,700 meters, where the temperature was —46°.5 C. An increase of 8°.9 occurred, however, in the first 3,000 meters, for above 15,500 meters nearly isothermal conditions prevailed, confirming the belief of Teisserenc de Bort that what he calls the "stratosphere" is composed of a lower inverting layer with isothermal conditions above extending to an unknown height. In an ascension last November in Belgium the

relatively warm stratum was found to extend from 12,900 meters to the enormous height of 29,000 meters, or 18 miles, where there was still no indication of its diminution.

A. LAWRENCE ROTCH

LETTERS FROM CHARLES DARWIN

IN 1882 I published in a history of Pettis County, Missouri, the following:

A flock of geese, belonging to ex-Marshall Kelly, of Sedalia, presents an interesting feature of malformations. In 1873 a gander had one of its wings so injured that it hung horizontally at right angles to the body, in the same manner as is not infrequently seen in other flocks, a result of injuries received. In 1874, one of the young of the flock presented a wing similarly affected; the following year its offspring showed the same features, and this has been continued to the present time. As many as two thirds of the flock have at one time presented this peculiarity, some in both wings. Believing that it was a case of "the inheritance of effects of injuries," Mr. R. A. Blair published an account of it, and sent a copy to Mr. Charles Darwin, and received from him the following letter:

Dear Sir: I am much obliged to you for kindly informing me of the case of the goose. It seems to be a remarkable case of inheritance of effects of injury, and as such cases are very rare, it would be quite worth while to have the facts carefully examined. If you could obtain a wing, and would send it to me, I should be much obliged. The wing might be cut off at the joint with the body, and dried with feathers on, before a hot fire. To make the case of more value, it would be very advisable to ascertain whether the goose had any offspring before the injury, and if so, whether they were normal, and not malformed in any way.

Dear sir, yours faithfully,

CHARLES DARWIN

Mr. Blair then sent a wing of one of the geese, and received the following answer:

Dear Sir: You will think that I have been very neglectful in not having sooner thanked you for the wing of the goose, the photograph, and your last interesting letter; but I thought it best to wait until receiving Professor Flower's report, and you will see by the enclosed the cause of his delay. If you are willing to take the trouble to get your interesting case thoroughly investigated, it will be necessary to procure from the owner the wings of a half dozen birds, some of them quite young; and, if possible, the old one which had his wing broken. They ought to be sent in spirits, and they had better be addressed to Professor Flower, Royal College of Surgeons, Lincoln's Inn Fields, London, and I had better be informed when they are dispatched. Should you be inclined to take so much trouble, I hope you will allow me to say that I should be very glad to pay for the geese, and for the several other contingent expenses. Your first letter and Professor Flower's had better be returned to me hereafter. There is one other point which ought, if possible, to be ascertained, viz: when the old gander had his wing broken, was it wounded so that blood was discharged? If wounded, did the wound suppurate? Did the wing heal quickly or slowly? These are important points in relation to the inheritance of mutilations. Pray accept my best tnanks for your kindness, and I remain, Dear Sir,

Yours faithfully,

CHARLES DARWIN

A number of wings were then sent to Dr. Flower, who made a report to Mr. Darwin, in which he says:

The bones, muscles, and ligaments seem quite normal, except for this twisting on their axis, which exactly corresponds, as I mentioned before, to *talipes* or club foot in man. The wings of the very little goslings being dried and very small could not be examined with any good result, but the most curious and unsatisfactory part of the whole thing is that the wing of the old gander, the supposed *fors et origo* of all the mischief, is perfectly normal, and presents no trace of ever having been injured in any way discoverable after the closest examination. It has certainly never been broken or dislocated, though, of course, we can not be sure whether it may not have had a partial twist from which it has now recovered.

With this letter and with the full and detailed report of Dr. Flower's assistant, Mr. Darwin wrote as follows:

Dear Sir: Professor Flower has suffered from a long illness, and this has caused much delay in the examination of the wings of the geese. But I received yesterday his report and letter which I enclose, as you may like to see them. I fear there is no connection between the deformity and the injury. The owner when he saw several goslings thus deformed, a not uncommon form of

quasi inheritance, remembered the accident, and naturally attributed the deformity to this cause. It has been probably a case of "post hoc" and not "propter hoc." I grieve that you should have expended so much time, trouble and great kindness in vain. As for myself I am well accustomed in my experimental work to get definite results but once in three or four times, and thus alone can science prosper. With my renewed thanks, I remain, Dear Sir,

Yours faithfully,

CHARLES DARWIN

The above publication did not give the dates of the letters; however, the first was in 1877 and the last in 1878.

F. A. SAMPSON

COLUMBIA, MO.

LUDWIG RUDOLPH SOPHUS BERGH

LUDWIG RUDOLPH SOPHUS BERGH was born in Copenhagen, October 15, 1824. His father was a military surgeon. Since his family was in moderate circumstances, he undertook at eighteen years of age to support himself during his student life, taking the medical course with zoology and general anatomy under the anatomist Ibsen and the distinguished malacologist Beck. His first paper, published in 1853, was a contribution toward a monograph of the Marseniidæ. In the same year, during the cholera epidemic at Copenhagen, he acted as one of the medical staff formed to combat the ravages of this disease. In 1860 he received his degree of doctor of medicine at the University of Copenhagen, and was appointed three years later head surgeon for dermatology and venerology in the General Hospital; in 1881 professor of these branches in the university, and in 1885 head surgeon in charge of the newly built Vestre Hospital, erected and fitted after his own plans. This responsible position he retained until 1903, when he retired for age; two years later he ceased his private practise, and soon after, by the failure of eyesight, was obliged to relinquish his microscopical researches. He died at Copenhagen, June 20, 1909, leaving a widow and one son, his namesake.

Dr. Bergh for many years stood at the head of the small group of malacological anatomists, devoting himself especially to the Opisthobranchiata and particularly to the group of Nudibranchiata. His published works on these animals form a small library and a mine of detailed information. The chief results of this unremitting labor are summed up in a large quarto in which he gives a complete systematic arrangement for these animals. Beside this contribution to the knowledge of molluscan anatomy he published several valuable memoirs on other groups of mollusks, an especially notable instance being a fine memoir on the anatomy of the genus *Conus*. He was largely concerned with the publication of the great posthumous series of quartos detailing the results of the researches in eastern seas by Carl Semper, who was his intimate friend. In medicine also, his publications, based on the treatment of thousands of hospital patients, took a high rank. He was naturally a member of most European societies and academies concerned in medicine or zoology, and was elected Huxley's successor in the corresponding membership of the Institute of France.

Personally, Dr. Bergh was most genial and agreeable in manner, ever ready to help younger students, or serve as cicerone to foreign colleagues visiting his beloved Copenhagen. Hospitable and unpretentious, a staunch friend and untiring student, his death leaves a gap in the ranks of the veterans which we may hardly hope to see filled, and a memory which those who knew him will cherish long.

WM. H. DALL

SCIENTIFIC NOTES AND NEWS

THE American Astronomical and Astrophysical Society held its tenth annual meeting at the Yerkes Observatory, Williams Bay, Wisconsin, on August 19–21. Fifty members were present and forty-one papers were presented. The following are the officers for the ensuing year: *President,* E. C. Pickering; *First Vice-president,* George C. Comstock; *Second Vice-president,* W. W. Campbell; *Secretary,* W. J. Hussey; *Treasurer,* C. L. Doolittle; *Members of the Council,* W. J.

Humphreys, Frank Schlesinger, W. S. Eichelberger, E. B. Frost.

DR. C. M. GARIEL, professor of medical physics at Paris, has been elected president of the French Association for the Advancement of Science for the meeting to be held next year at Toulouse.

AMONG those who were given doctorates of philosophy at the recent Leipzig celebration are Sir Archibald Geikie, the geologist, and Dr. James Ward, professor of philosophy at Cambridge.

DR. HARVEY CUSHING, of the Johns Hopkins University, gave the William Banks memorial lecture at the University of Liverpool on August 4. He treated the pathology and surgery of intracranial tumor.

THE German Association of Men of Science and Physicians has awarded the income ($750) of the Trenkle Foundation to Dr. F. Harms, of Würzburg, for his work on the electromagnetic theory.

MR. EDW. M. EHRHORN, at present deputy horticultural commissioner of California, has accepted the appointment of superintendent of entomology of the Hawaiian Board of Agriculture beginning on October 1. Mr. Jacob Kotinsky resumes the post of assistant entomologist with the board.

DR. ARNOLD RUGER, of Heidelberg, proposes to edit a year book of philosophy, and will be glad to receive copies of papers bearing on philosophy, psychology, logic, ethics and esthetics, which should be sent care of Weiss-'chen Universitäts Buchhandlung, Heidelberg.

MR. CHARLES LOUIS POLLARD, curator-in-chief of the Museum of the Staten Island Association of Arts and Sciences, and Mr. George P. Engelhardt, assistant curator in the Children's Museum of the Brooklyn Institute of Arts and Sciences, have returned from a field trip in North Carolina. They explored Roanoke Island and Smith's Island and also paid a brief visit to the mountains in the vicinity of Blowing Rock and Linville Falls. A large collection of insects and some reptiles and batrachians were obtained.

ON August 17, Mr. Carl E. Akeley, formerly of the Field Museum of Natural History, and Mrs. Akeley sailed *en route* for British East Africa. This is the third trip in the interest of science, the two former ones being for the Field Museum and the present one for the American Museum of Natural History. The expedition will require two years and besides obtaining a group of elephants to be mounted amid a reproduction of their natural habitat in the American Museum, much time will be spent in making a very complete photographic record of the people, fauna and flora. A moving picture camera is being taken and pictures of army ants on the march and other movements of animals will be attempted. Mr. Akeley has just completed the new elephant group at the Field Museum and was the creator of the well-known deer group also in the Chicago institution.

UNDER the presidency of the United States ambassador, Professor Osler will deliver the inaugural address of the winter session of the London School of Tropical Medicine on October 26.

DR. EARL LOTHROP has been elected president, and Dr. Harry R. Trick, secretary, of the Buffalo Academy of Medicine.

THE Wesley M. Carpenter lecture for 1909 before the New York Academy of Medicine will be delivered on October 21 by Dr. H. T. Ricketts, professor of pathology in the University of Chicago, on "Some Aspects of Rocky Mountain Spotted (Tick) Fever, as shown by Recent Investigations." The anniversary address, on November 18, will be made by Dr. Louis Livingston Seaman, late major and surgeon, U. S. Engineer Corps, on "Personal Observations on the Sleeping Sickness in Central Africa."

DR. WILLIAM BRODIE, biologist of the Provincial Museum of Toronto, who had made valuable entomological and other biological collections, died on August 6, at the age of seventy-eight years.

PROFESSOR EMIL HANSEN, the eminent physiological botanist, known especially for his work on microorganisms and alcoholic ferments, died on August 27, at the age of sixty-seven years.

Mr. William Ford Stanley, the maker of scientific instruments and author of contributions to physical and astronomical science, died on August 14, at the age of eighty-one years. Mr. Stanley built and endowed the Stanley Technical Trade Schools at Norwood.

Dr. Viktor Kremser, chief of division of the Meteorological Institute of Berlin, has died at the age of fifty-one years.

Mrs. Nelson Morris has endowed with $250,000 an institution in Chicago to be called the Nelson Morris Memorial Institute of Medical Research. It will be connected with the Michael Reese Hospital, of which Dr. John Hormsby is the superintendent and Dr. James W. Jobling chief pathologist. Dr. Jobling will direct the scientific work of the institute.

The Dallas (Texas) Medical and Surgical Building Association has been organized to erect an office building to be devoted to professional men entirely and to cost $500,000.

The Public Health and Marine-Hospital Service has taken steps looking to the establishment of a branch of its Federal Laboratory on the Pacific coast in the zone of squirrel plague infection.

The general assembly of Georgia has through the initiative of Dr. A. M. Soule, president of the State Agricultural College, appropriated $10,000 for educational work at farmers' institutes throughout the state.

The fourth International Congress of Aeronautics will be held from September 18 to 24 at Nancy. Proceedings will be divided into three main sections: (1) aerostation, (2) aviation, (3) legislation and general subjects.

A telegram has been received at the Harvard College Observatory from Professor H. Kobold of Kiel, stating that Perrine's comet was observed by Kopff August 12.42.99 G.M.T. in R.A. $0^h\ 17^m\ 8^s$ Dec. $+35°\ 32'$. The object is visible in a large telescope.

It appears from the daily papers that at the meeting of the Association of State and National Food and Dairy Departments, at Denver on August 26, a vote of 57 to 42 was passed in favor of the following resolution:

Resolved, That this association hereby indorses the report of the Referee Board of Consulting Scientific Experts, appointed by Secretary of Agriculture Wilson at the direction of President Roosevelt upon the use of benzoate of soda in food products.

According to press despatches, valuable deposits of radium-bearing pitchblende have been discovered on the McCloud River, Cal. It is also reported that pitchblende has been discovered in Cripple Creek district of Colorado.

President Taft has issued a proclamation setting aside the Oregon caves in the Siskiyou National Forest in the state of Oregon as a national monument. The area of the reservation is about four hundred and eighty acres.

The department of plant pathology of the New York State College of Agriculture at Cornell University, Ithaca, N. Y., announces the establishment of a temporary industrial fellowship by the Niagara Sprayer Company of Middleport, N. Y. The purpose of this fellowship is to investigate the value of commercial lime-sulphur mixtures as fungicides. The fellowship is established for two years at a salary of $1,000 a year, and with a maximum sum of $500 annually, for the carrying on of the investigations. By the terms of the fellowship the College of Agriculture is left perfectly free to carry on the investigations in any way it may see fit, and to freely publish all the results at any time. Mr. Errett Wallace (Cornell, B.S.A. '08, M.S.A. '09) has been elected to the fellowship. The investigations will be conducted in field laboratories, situated somewhere in the state of New York. The work for the present season is being conducted on the fruit farm of Mr. L. B. Frear, near Ithaca, N. Y. The chief problem for investigation at present is to determine the efficiency of the commercial lime-sulphur mixtures as a summer spray for the control of peach and apple diseases.

It is reported by cable that the debt incurred by Lieutenant E. H. Shackleton and the members of the family for his Antarctic expedition is to be liquidated by the government. Premier Asquith has announced in the

House of Commons that he would ask the house to vote $100,000 for that purpose. Previously Mr. Shackleton had issued a statement in which he said:

When, after great difficulty, I had secured sufficient promises of support to enable me to announce the expedition on February 12, 1907, I proceeded to make my preparations with a view to leaving England in July of that year. My supporters were various relatives and friends in this country—not in the United States as has been declared—but, owing to the American financial crisis and the resulting financial stringency in this country, some of the money promised to me did not become available. When I found that the promises of support could not be carried out, I went to several rich men, and they very generously guaranteed me at the bank to the extent of £20,000, on the understanding that the guarantees were to be paid off by me not later than July, 1910. The arrangement was that the bank should advance the money on the guarantees and that I should pay interest. I can not thank too warmly those who had faith in me when comparatively unknown. When I arrived in Australia on my way south, I made application to the Commonwealth government for assistance, and I was at once given a sum of £5,000 for the purposes of the expedition. The New Zealand government further gave me £1,000, paid half the cost of towing the *Nimrod* to the Antarctic, and assisted me in various other directions. This sum of £6,000 enabled me to increase my staff and to secure additional stores and scientific equipment. The position now is that the guarantees to the extent of £20,000 have to be released, and this, I hope, will be done by the sale of my book and by my lectures and the money that my wife's relatives and myself and friends have contributed. Apart from this, of course, the cost of the expedition was far in excess of £20,000. I should like it clearly understood that since my return I have not approached his majesty's government in the matter and it can not justly be said, therefore, that they have declined to contribute.

UNIVERSITY AND EDUCATIONAL NEWS

ILLINOIS WESLEYAN UNIVERSITY has received $30,000 from Mr. Andrew Carnegie for a new science building.

MR. NEIL MACNEIL, of Boston, has presented to St. Francis Xavier's College, Nova Scotia, for the use of its professors, a seaside resort—a block of land with a completely equipped summer home—at Mahanny's Beach, on the shore of Bay St. George.

MRS. ELIZABETH MURDOCK, the widow of a Liverpool shipowner, has bequeathed £2,000 to the University of Liverpool to found engineering scholarships.

THE College of Physicians and Surgeons of Los Angeles has consolidated with the College of Medicine of the University of Southern California. The name of the consolidated school will be College of Physicians and Surgeons, Medical Department of the University of Southern California.

THE Hong-kong and Shanghai Bank has made a donation of £4,500 for the Hong-kong University.

THE governor of Madras opened on July 14 a new agricultural college and research institute at Coimbatore. Rooms are provided for chemistry, physics, botany, entomology and mycology.

EDINBURGH UNIVERSITY has decided to send its scholarship men to the Iowa State College to pursue graduate work in animal husbandry. Two of these men are now on their way from Scotland.

DR. J. H. KASTLE, chief of the division of chemistry of the Hygienic Laboratory of the U. S. Public Health and Marine Hospital Service, will at the opening of the academic year assume the duties of professor of chemistry at the University of Virginia. Dr. J. W. Mallet, professor of chemistry since 1885, who will celebrate his seventy-seventh birthday on October 10, has been made professor emeritus under the Carnegie Foundation.

MR. MELVIN E. SHERWIN, instructor in astronomy in the University of California, has been appointed assistant professor of astronomy in the University of Maine.

MR. W. H. HADOW, fellow and tutor of Worcester College, Oxford, has been appointed principal of Armstrong College of Durham University at Newcastle-on-Tyne, in succession to Sir Isambard Owen, who has accepted the vice-chancellorship of Bristol University.

DISCUSSION AND CORRESPONDENCE

ON THE INHERITANCE OF ANILINE DYE

In one of the German magazines I have found a short account of Dr. Riddle's work, "On the Inheritance of Aniline Dye," published in Science. Dr. Riddle showed that the yolks and embryos of the eggs laid by hens which were fed with the dye Sudan III. were colored. As in the account the remark is made that since the year 1896, when an Italian, Daddi, discovered that Sudan III., given as nourishment, possesses a staining power, no one has undertaken any further experiments upon animals with this dye, I should like to state that my experiments carried out in Professor Dr. Hoyer's laboratory, and entitled, "Contribution à la biologie des teignes," were already published in the year 1905 in the "Bulletin intern. de l'Academie des Sciences de Cracovie, 1905."

Giving wool together with the dye Sudan III. as food to the caterpillars of a certain moth (*Tineola biselliolla* Hummel), I caused their bodies to be colored red. Their adipose tissue was the most intensely stained. The larvæ thus colored undergo normal metamorphosis, the pupæ and also the butterflies produced from them continue to preserve the typical red color of Sudan. The tinge of the head, thorax, abdomen and limbs of a butterfly may be easily seen with the naked eye beneath the scales covering the body. In general this coloring makes its appearance where adipose tissue is present. There is also an accumulation of dye in the female's ovary. In the cells surrounding an egg there are seen small drops of fat stained with Sudan. The eggs laid afterwards look reddish and the drops of fat contained in them have the very characteristic color of Sudan. Thus, by feeding the larvæ of one generation with Sudan, I obtained all the stages of development of the moth colored with the same dye, and this dye was later transferred into the reproductive cells of the same generation. From all this we may conclude that the reserve material accumulated by a larva in the form of fat serves not only for one stage of development, but is also transferred almost without change and is of use in the further development of the insect. Besides, the dye, introduced into the organism of an individual as a material admixture, is transmitted by means of the reproductive cells to the offspring and in this manner it may be inherited.

In later researches, the results of which are not yet published, I have proved that larvæ, hatched from eggs colored with Sudan, possess its special tinge of red. I have also succeeded in obtaining similar results, when using a series of dyes of different colors, *e. g.*, blue, and in experimenting with different kinds of butterflies and other insects.

Ludwik Sitowski

NON-FRUITING OF JAPAN PERSIMMONS DUE TO LACK OF POLLEN

Since its introduction in the seventies, the Japan persimmon has received a considerable amount of attention from growers and investigators. Its culture has gradually increased until it is now cultivated to a greater or less extent over a fairly wide area, a section corresponding roughly with that in which cotton can be produced.

Complaint has many times been made that the Japan persimmon does not hold its fruit, that it blooms profusely, but the young fruits drop off shortly after the flowering period is past; in fact, at this time, each season, the ground under large trees is often literally covered with the calyces and ovaries of the plant. At harvest time, either not a single fruit remains or only a few scattered specimens on trees which should have borne bushels of luscious fruit.

Various reasons have been given for this phenomenon, such as lack of necessary food supply, lack of moisture or uncongenial soils, and the remedies suggested and most frequently put into effect have been more frequent cultivation, no cultivation at all and heavy applications of fertilizers, particularly potash; but in spite of all these, the Japan persimmon has continued to behave in much the same way, some varieties holding a fair crop, others none, bearing one year and not another. There has always been something

extremely erratic in their behavior. It would appear that the problem is not one of cultivation or fertilization and the cause and remedy must be sought in an entirely different direction.

While it is a fact, well known to botanists, that plants of the genus *Diospyros* are diœcious (occasionally polymorphous or monœcious), yet the question of sex as related to the non-fruiting of the Japan persimmon, *D. Kaki,* appears to have been entirely overlooked. Examination, both macroscopical and microscopical, of hundreds of flowers of different varieties shows that the stamens in the pistillate flowers are abortive and no pollen is borne in them. Without question, herein lies the reason for Japan persimmons so often setting no fruit, or only a very light crop—an abundant supply of pollen at the proper time is lacking and the only source of pollen for the Japan persimmon is the chance supply furnished by staminate trees of *D. Virginiana.* So far as the records show, no male trees of *D. Kaki* have been brought to this country. A change in orchard practise is needed, and as in the culture of Smyrna figs or dates, carob bean and pistache nut, the planting of male trees to supply pollen is a necessity, so in orchards of Japan or other persimmons, the presence of male persimmon trees, covering the blooming period, is necessary to secure an abundant setting of fruit. To this there are doubtless exceptions, as some varieties (Tane-Nashi, for instance) are almost invariably seedless and apparently set and mature fruit without being pollinated. Seedlessness is in many cases due to environment and is not an inherent character in fruits. It is often due simply to lack of pollen.

It is possible that some specimens of *D. Kaki* in this country do produce pollen-bearing flowers, but such trees are extremely rare, and in ten years of observation, but one such tree, a monœcious specimen of Tabers No. 23 has been noted. So infrequently do such occur, it may not be too much to say that all Japan persimmon seedlings originated in this country have a strain of some other persimmon (usually *D. Virginiana*) in them.

The problems connected with this matter are being carefully investigated.

H. HAROLD HUME
GLEN SAINT MARY, FLORIDA,
May 10, 1909

SCIENTIFIC BOOKS

The Rise and Progress of the British Explosives Industry. Published under the auspices of the Seventh International Congress of Applied Chemistry by its Explosives Section. Small quarto; pp. 418; 39 illustrations. New York, Whittaker and Co. 1909.

This is the first fruit of the congress held in London, May 28 to June 2, 1909, which was attended by some 3,000 members. This book originated in a suggestion made to the Committee of the Explosives Section, which has financed the project, on December 5, 1908, and it is the product of the joint efforts of a large number of collaborators, most of whom are intimately connected with the special branches of the industry of which they treat, under the supervision of Mr. E. A. Brayley Hodgetts, editor. The contents are classified into an Historical Part, treating of gunpowder, nitrocellulose, nitroglycerine and its derivatives, permitted explosives, percussion caps, Bickford's safety fuse, fireworks, legislation, bibliography, chronology and list of gunpowder makers; and a Descriptive Part, treating of the three existing government establishments and some fifty-four private establishments.

The bibliography and chronology fill some 132 pages, while there are, in addition, considerable lists of papers and patents attached to some of the special articles, and these are quite useful, but the special articles, as might be expected from so large a number of contributors, and especially where so many of them are engaged in other than literary or scientific pursuits, exhibit a marked unevenness in the method of treatment and the quality of the product. This lack of system is especially to be noted in the part devoted to private establishments where the accounts vary from a two-line notice of one establishment to a ten-page description of another.

In fact, a large part of the text could have

been omitted without serious loss, yet the research student must examine it in detail, since there occurs from time to time statements such as "This 'heat test,' as it was called, invented and perfected by the late Dr. Dupré, chemical adviser to the home office, is in universal use to-day: it is a test for the purity of guncotton, nitroglycerine and freshly made explosives, and the home office has so far found nothing to supersede it," for from 1896, at least, when P. Gerald Sanford published his "Nitro-Explosives" in London, to 1909, when Dr. H. Kast published his "Anleitung zur chemischen und physikalischen Untersuchung der Spreng- und Zündstoffe" in Brunswick, this stability test has been almost universally styled the Abel heat test, and in view of such governmental publications as that issued from Woolwich, under date of February 11, 1874, it has seemed proper to do so, but of course we must recognize the primary right of the English people to determine questions of priority between their own investigators. They should, however, also resolve the conflicting claims to invention and ownership of modern explosives set forth in these pages by the representatives of private establishments.

As indicated above, the book is a disappointing one and most so in the matter of statistics, for while the rise of an industry in its various phases may be set forth chronologically, the progress is to be measured quantitatively, and yet one searches these pages in vain for the quantities of the explosives of various kinds produced at different periods. It is true that the report of the Nobel's Explosives Company, Limited, shows that, starting in 1871 with a capital of £24,000, it accumulated reserves which were capitalized in 1900 at £800,000, in addition to which debentures to the value of £500,000 were issued, and that, by 1909, it owned nine factories, the chief one known as the Ardeer Factory, occupying 837 acres, containing 1,004 buildings, and employing 2,300 foremen and laborers, together with 35 chemists. Had the editor arranged a system of reporting whereby the other establishments made returns of items similar to these just cited, some measure of progress would have been presented.

In one regard the book is a surprise, for claims to preeminence are set forth in it in no uncertain tones and it may be read with comfort by Americans who are restive under foreign criticism. In fact, in many regards, the book suggests those which may be found in hotels and on routes of travel frequented by commercial travelers.

Charles E. Munroe

Phrenology or the Doctrine of the Mental Phenomena. By J. G. Spurzheim. Revised edition from the second American edition, published in Boston, 1833. With an introduction by Cyrus Elder. Philadelphia and London, J. B. Lippincott and Company. 1908.

This is a reprint, without change in the text, except the omission of Spurzheim's reflections upon the moral and religious constitution of man, his voluminous Latin notes and a controversy with George Combe, of the antiquated "phrenology" which sought to define the intellectual and affective powers of the mind, be they perceptive or reflective, propensities or sentiments, in terms of parts that can be distinguished by the external configuration of the head. A frontispiece shows the familiar charts of the head in three views, setting forth with great thoroughness the location of each and all of the powers of the mind. Fourteen plates show portraits of men, bull-dogs and horses, with "readings" of the various "organs" indicating *destructiveness, amativeness, philoprogenitiveness, inhabitiveness, benevolence, ideality* and so on.

Phrenology has had its day, of even shorter duration than alchemy or astrology, alike empiric and mystic, though it can not be denied that Gall and Spurzheim, particularly the former, did much to prepare the foundation for the rising superstructure of proved facts regarding the brain and mind. Even modern attempts to revert to phrenology and phrenologic methods in localizing the passions and emotions—that is, the subtle moral qualities as distinguished from the intellect—such as the pretentious work of Bernard Holländer have failed signally to convince.

One is curious to know why such an obsolete work was deemed worthy of reprinting at this time and after the lapse of more than sixty years. Cyrus Elder, who writes the introduction, is evidently a layman in matters anatomic and psychologic and therefore doughtily attacks the doctor of medicine and the psychologist as knowing nothing of the mind in the one case and nothing of the brain in the other. Mr. Elder is either innocent of knowledge of, or he ignores the results of, patient researches conducted along clinico-pathologic, experimental, physiologic and developmental lines which have furnished us with a good working map of the somesthetic and sense-areas and, inferentially, of the association-areas of the cerebral cortex. But even such a topographic map, delineating areas called *motor, visual, auditory* and so on, is not to be considered as mathematically accurate or sharply defined as the areas of a state, county or township. The areas rather shade off in a diffuse manner and really show only the maximum concentration of those cortical parts which most distinctly appertain to the function alleged for them. Also, while less than one third of the cortical expanse is directly concerned with receptive and emissive functions, the remainder is presumed to be devoted to the elaboration of the higher mental activities manifested in abstract thought, ideation, reasoning and language. Further than this, present-day cerebral localization of function in the cortex does not pretend to go. Although an aggregation of psychic areas and therefore the seat of the will, the neuronic connections of any portion of the cortex with other cortical parts and of these with other centers in the brain, are so intricate, complex and interdependent that all search for isolated "centers" of moral qualities, qualities of consciousness, has thus far been quite futile. Of the neurone, the developmental, structural and functional unit of the nerve-system, and of the grouping and chaining of neurones as revealed by modern methods of investigation, Gall and Spurzheim knew nothing, of course; apparently the editor of the volume before us is no better off.

With the increase of the intellectual faculties in the course of evolution, the brain has developed in bulk and complexity and with it the skull has undergone expansion and modification of form. Some of the intellectual faculties have found somatic expression in the relative expanse of certain cortical areas and these in turn have exerted some influence upon the configuration of the skull, but not to the degree nor of the same kind of protuberances that Gall and Spurzheim's phrenology proposed; protuberances, by the way, which in certain instances overlie normally variant air-sinuses, blood-sinuses, sutural thickenings or muscle.

Unless it be that a certain historic interest attaches to a work which for a time attracted attention and even afforded disciples of its doctrines a means of livelihood, and which may be regarded as a stepping-stone toward modern cerebral physiology, the reprinting of Spurzheim's work must be regarded as a somewhat otiose undertaking.

EDW. ANTHONY SPITZKA
JEFFERSON MEDICAL COLLEGE,

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Biological Chemistry, Vol. VI., No. 3, June, 1909, contains "The Mode of Oxidation in the Organism of Phenyl Derivatives of the Fatty Acids": Part IV., Further Studies on the Fate of Phenylpropionic Acid and Some of its Derivatives; Part V., Studies on the Fate of Phenylvaleric Acid and its Derivatives; Part VI., The Fate of Phenylalanine, Phenyl-β-alanine, Phenylserine, Phenylglyceric Acids and Phenylacetaldehyde, by H. D. Dakin. These papers are a continuation of the author's earlier work on the mode of catabolism of fatty acids. They show the stages through which the substances studied pass in their transformation in the body and lead to the view that the catabolism of a fatty acid group is effected by the removal of two carbon groups at a time. This process is termed by the author "successive β-oxidation" and is believed to be a general biochemical reaction. "The Nuclein Ferments of Yeast," by M. N.

Straughn and Walter Jones. Yeast contains guanase but not adenase or xanthoöxidase. "Further Studies on the Use of the Fermentation Tube in Intestinal Bacteriology," by A. I. Kendall. Explanations of commonly observed discrepancies in the study of intestinal flora by means of the fermentation tube. "The Metabolism of Man during the Work of Typewriting," by Thorne M. Carpenter and Francis G. Benedict. Estimations of oxygen consumption, carbon dioxide exhalation and heat production show that the energy transformation during the work of typewriting is less than that occurring in ordinary walking.

SPECIAL ARTICLES

A SUCCESSFUL OVARIAN TRANSPLANTATION IN THE GUINEA-PIG, AND ITS BEARING ON PROBLEMS OF GENETICS[1]

Transplantation of the ovary from one animal to another has often been attempted, and with varying degrees of success. The object has usually been to observe the effects of the transplantation upon the animal into which the foreign ovary was introduced. Recently, however, the experiment has been repeated by students of genetics, to discover, if possible, what the effect would be upon the germ-cells, of a transfer from their normal environment to the body of a different individual. The most noteworthy results thus far[2] reported are those of Guthrie on hens, and of Magnus[3] on rabbits. Each apparently working without knowledge of the other's work has obtained what seems to be a modification of the coloration of the offspring, due to influence exerted by the foster-mother upon the germ-cells liberated within her body from the introduced ovary. But in the work of neither of these experimenters does the nature of the result obtained preclude the possibility that the ova liberated may have come from regenerated ovarian tissue of the mother herself rather than from introduced ovarian tissue. The theoretical importance of this point led us about a year ago to plan experiments which should not be open to the objection which we have stated. We therefore undertook the transfer of ovarian tissue from a Mendelian dominant to a Mendelian recessive individual. For if in such a case germ-cells were liberated which bore the dominant character, we should know that they could have come only from the introduced tissue, since recessive individuals are themselves incapable of liberating dominant germ-cells.

We are now able to report partial success. The ovaries were removed from an albino guinea-pig about five months old, and in their stead were introduced the ovaries of a black guinea-pig about one month old. The albino upon which the operation had been performed was then placed with an albino male guinea-pig, and six months later bore two black-pigmented young.

In all recorded observations upon albino guinea-pigs, of which we have ourselves made many hundred, albinos when mated with each other produce only albino young. Accordingly there seems no room for doubt that in the case described the black-pigmented young derived their color, not from the albino which bore them, but from the month-old black animal which furnished the undeveloped ovaries, for transplantation into the albino. As regards the important question whether, in such an experiment as this, the germ-cells are modified in character by the changed environment within which they are made to grow, our results are at variance with those of Guthrie and Magnus. *We can detect no modification.* The young are such as might have been produced by the black guinea-pig herself, had she been allowed to grow to maturity and been mated with the albino male used in the experiment.

We have now under observation about seventy-five other guinea-pigs, as well as a number of rabbits, upon which similar operations have been performed. From some of these we hope to obtain further results.

[1] Contributions from the Laboratory of Genetics, Bussey Institution, Harvard University, No. 1.

[2] *Journal of Experimental Zoology*, Vol. 5, p. 563, June, 1908.

[3] *Norsk magazin for lægevidenskaben*, No. 9, 1907.

We are indebted to Dr. Alexis Carrel, of the Rockefeller Institute, for valuable suggestions as to operative technique, and to the Carnegie Institution of Washington for material assistance through a grant to the senior author.

W. E. CASTLE,
JOHN C. PHILLIPS
FOREST HILLS, BOSTON, MASS.,
August 11, 1909

THE PECULIAR INHERITANCE OF PINK EYES AMONG COLORED MICE[1]

READERS of SCIENCE are well acquainted with the fact that color-inheritance in mice presents many difficult problems. To one of these problems we are hopeful that we have found a solution. Mice occur in the same fundamental color-varieties as guinea-pigs, most of which are found also among rabbits.[2] These color varieties occur in two series, one the usual or intense series, the other a dilute or pale series. Bateson (1909) considers the pale series a quantitative modification merely of the intense series, but there are some reasons for regarding it as a qualitative modification. But whichever it may prove to be, the dilution is demonstrably interchangeable from one color variety to another, so that it may conveniently be treated as due to an independent factor.

Mice are peculiar in that they possess another series of color varieties, or really two other series, as we shall try to show, not found in mammals generally.

In this series the eye is apparently pink, but in reality, as Miss Durham has shown, it is very slightly black or brown pigmented. Further, black or brown pigments of the coat, if present, are pale in pink-eyed mice.

We find, however, that the paleness of the pigments in such cases is not commonly due to the same factor as the paleness of coat in the dilute series having dark eyes, but to a different factor which may or may not be associated with the dilution factor and which we regard as a *quantitative* modification of the pigmentation, while the dilution may be regarded as a *qualitative* modification of it.

We recognize, accordingly, four series of color varieties among mice, two dark-eyed and two pink-eyed. Dark-eyed and pink-eyed may each occur in an intense series and in a dilute series. The reason that they have not been recognized sooner is that the intense pink-eyed animal is really less heavily pigmented than the dilute dark-eyed animal of the same color-type, and so *all* pink-eyed animals have been considered *dilute*. But that such is not the case is shown by the following experiment. If a pink-eyed gray (intense) animal is mated with a dark-eyed pale cinnamon (dilute) the young are all both dark-eyed and intense; namely, the color of wild house-mice (gray).

Now if such grays are bred together they produce: (1) grays (both intense and dark-eyed); (2) blue-grays (dilute and dark-eyed); (3) pink-eyed grays (intense but with reduced amount of pigment), and (4) pink-eyed pale-grays (dilute and with reduced amount of pigment). Manifestly this is a case of Mendelian dihybridism, in which the pigmentation has been modified in two different ways. Each modification affects the fundamental color-factor, *C*, and may be transmitted through albinos, or from one color variety to another. For convenience of reference we place in a table the names of the four series of color-varieties which we recognize. Most of these have already been identified but there is still uncertainty about a few of them. In the table p. means pink-eyed as well as "paucity" of black or brown pigment in the coat.

The albinos being wholly unpigmented are indistinguishable in the several series except by breeding tests.

A specific experiment illustrative of the foregoing account, though involving a greater number of factors, is the following.

[1] Contributions from the Laboratory of Genetics, Bussey Institution, Harvard University, No. 2.

[2] See SCIENCE, January 25, 1907; August 30, 1907; August 21, 1908.

[3] The coat looks to the unaided eye very similar to that of the dark-eyed pale cinnamon.

[4] This variety has a coat much less heavily pigmented than the dark-eyed blue, but if crossed with cream it produces black and gray young, not blue and blue-gray.

Series 1 Dark-eyed Intense	Series 2 Dark-eyed Dilute	Series 3 Pink-eyed Intense	Series 4 Pink-eyed Dilute
Gray	Blue-gray	p. Gray[3]	p. Pale gray
Black	Blue	p. Blue[4]	p. Pale blue
Cinnamon	Pale cinnamon	p. Cinnamon	p. Pale cinnamon
Chocolate	Pale chocolate	p. Lilac	p. Pale lilac
Yellow	Cream	p. Yellow	p. Cream
Albino	Albino	Albino	Albino

A *dilute* dark-eyed cinnamon ♀ 682 was mated with a *pink-eyed* gray ♂ 691. From this mating fifteen young were obtained, all *intense* dark-eyed grays (like the wild house-mouse).

From these grays, when bred together, there have been obtained up to the present time fifteen young of at least six different color varieties distributed as shown below. On the hypothesis, which we have advanced, the expected number of varieties is eight; their expected frequencies in a total of sixty-four young are also shown below. It is not surprising that, in so small a number of young as fifteen, two of the smallest of the expected classes should be unrepresented, but it is not yet certain that they are unrepresented, since the visible difference between p. cinnamons and p. grays is probably so slight that breeding tests may be required to differentiate the two classes.

	Dark-eyed				Pink-eyed			
	gray (intense)	blue gray (dilute)	cinnamon (intense)	pale cinnamon (dilute)	p. gray (intense)	p. pale gray (dilute)	p. cinnamon (intense)	p. pale cinnamon (dilute)
Expected	27	9	9	3	9	3	3	1
Actual	4	3	2	1	4?	1?	?	?

The cross is evidently one involving three independent Mendelian factors, viz., (1) black *vs.* brown pigmentation; (2) intense *vs.* dilute pigmentation; and (3) dark-eyed *vs.* pink-eyed (or, as we should prefer to call it, the full amount of pigment *vs.* a reduced amount).

The known Mendelian factors concerned in the color variation of mice now number nine. They are:

1. *C,* the general *color* factor, the basis of all pigment in the skin and coat; its three modifications follow next.

2. *d,* the *dilution* factor.

3. *s,* the factor which causes *spotting* with white.

4. *p,* the *pink-eye* (or *paucity*) factor; next follow the three specific color factors and their two modifiers.

5. *Y,* the *yellow* factor.

6. *Br,* the *brown* or chocolate factor.

7. *B,* the *black* factor.

8. *R,* the *restriction* factor, which when present restricts black and brown pigments to the eye and leaves the coat yellow.

9. *A,* the *agouti* factor which operates by excluding black and brown pigments from particular parts of the hair, thus producing the ticked gray or cinnamon coat.

An explanation of the symbols chosen to express these factors will be given elsewhere. Grateful acknowledgment is made of assistance rendered by the Carnegie Institution of Washington through a grant to the senior author.

W. E. Castle,
C. C. Little

Forest Hills, Boston, Mass.,
August 11, 1909

THE FORTIETH GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY. III

Division of Physical and Inorganic Chemists

Charles H. Herty, chairman

Wilder D. Bancroft, secretary

On the Volumetric Estimation of Uranium and Vanadium: Edward DeMille Campbell and Chas. E. Griffin.

A brief review of the methods previously published is given. Experiments show that vanadium may be satisfactorily determined by reduction with sulphur dioxide and titration with permanganate and vanadium and uranium together may

be reduced by boiling with a spiral of heavy aluminum wire and titration with permanganate after the removal of the aluminum wire spiral and addition of excess of ferric sulphate.

In the analysis of carnotite ore after solution of the ore in nitric acid and evaporation with sulphuric acid the vanadium and uranium are separated from iron by double precipitation of the latter with sodium carbonate in the presence of a little hydrogen peroxide. In the acidified solution the vanadium is first determined by reduction with sulphur dioxide to V_2O_4 and titration with standard permanganate, after which the vanadium is reduced by boiling with aluminum to V_2O_3 and the uranium to UO_2. After complete reduction of the uranium and vanadium acidified ferric sulphate is added and the solution titrated with standard permanganate.

The Development of Positives after Short Exposures: WILDER D. BANCROFT.

If we expose a plate for ten minutes on a sunny day, the plate will develop as a positive instead of a negative. The theory of this phenomenon is quite simple and I need not go into it now. My problem to-day is how to produce the same result with a short exposure in the camera as with a long one, and we have worked out three methods of doing this.

The first way is to make the plate much more sensitive to light. This can be done by dipping the plate in a developer solution and exposing it wet. The light acts in the presence of a powerful depolarizer, the developer, and in consequence the chemical action is much greater for a given exposure. Incidentally, this method can also be used for shortening the exposure necessary to produce a negative.

The second way is to expose the plate after it has been in the camera to a uniform light for a short time. Since the sensitiveness of the plate to light of a given wave-length changes during the exposure, we can change the amount of contrast by changing the color of the fogging light. A more satisfactory result is obtained with a greenish-blue light rather than by the white light which has ordinarily been used. Since the intensity of the fogging light is greater at the air side of the film than at the glass side, the decomposition of the silver bromide is consequently greater there. By use of a suitable developer, we have succeeded in developing a plate so that there is a positive image on the air side and a negative image on the glass side.

The third method is that of a slow reduction before development. If the films in a kodak are not developed until several months after the exposure, there is always the possibility of their developing as positives. This is undoubtedly due to slow decomposition of the film which reduces the silver bromide to a lower stage and therefore duplicates the effect of a longer exposure. We have produced the same effect in the laboratory under somewhat definite conditions. The plate is left for a long time in a very weak developer and is then treated with an ordinary developer. As was predicted, the plate develops as a positive under these circumstances.

A fourth method is to add sulpho-urea to the developer as suggested by Waterhouse. This method gives beautiful positives; but we are not yet certain as to the theory and we are still working at this.

The Condensation of Water by a Substance in Solution: F. K. CAMERON and W. O. ROBINSON.

The condensation of water due to the presence of dissolved electrolytes is calculated from accurate specific gravity determinations on solutions of concentrations below 0.1 normal. In the cases of solutions of hydrochloric and nitric acids the concentration-condensation curves pass through maximum points. The investigation was undertaken primarily to find the effect of condensation, by a substance in solution, on suspensions and flocculation, but no generalizations of a causal character can be made from the data obtained.

The Dielectric Constants of some Inorganic Solvents: OSCAR C. SCHAEFER and HERMAN SCHLUNDT.

This communication is a continuation of the earlier work of Schlundt on the dielectric constants of inorganic solvents. The values obtained for the three halogen hydrides—hydrogen iodide, hydrogen bromide, hydrogen chloride—have been determined. The value of the dielectric constant of solid hydrogen cyanide is also reported as new value, that of the liquid having been published some years ago.

Solvents for Use with the Munroe Crucible: OTIS D. SWEET.

About forty-five solvents are enumerated. A table including about 120 precipitates and the corresponding solvents is also given.

Organic Amalgams: H. N. MCCOY and W. C. MOORE.

Discoveries in radioactivity in the last decade clearly show that some, at least, of the metallic

elements are not permanent, but disintegrate spontaneously, forming other elements. On the other hand, many organic radicles behave like elements, passing unchanged through many transformations. The ammonium radicle, in the form of ammonium amalgam, has marked metallic properties. We have made other amalgams of compound radicles, one of which, that of tetramethyl ammonium, has properties more typically metallic than has ammonium amalgam.

Tetramethyl ammonium amalgam is readily obtained by the electrolysis of an absolute alcohol solution of tetra-methyl ammonium chloride at 0°. Unlike ammonium amalgam, the new organic metal does not have any tendency to puff up; at 0° to 20°, it is a crystalline solid of characteristic metallic luster. If dry, it is stable at —80°; but decomposes at the rate of about five per cent. a minute at 20°. It reacts violently with liquid water, giving a variety of products and in addition colloidal mercury. When exposed to air at room temperature, it reacts with the moisture and becomes covered with a white coating of tetramethyl ammonium hydroxide—a reaction completely analogous to that shown by sodium amalgam. It precipitates metallic copper from an alcoholic solution of cupric nitrate and metallic zinc from an alcoholic solution of anhydrous zinc chloride.

The single potential difference between the amalgam and a semi-normal solution of the chloride at 0° is nearly two volts. This remains nearly constant for many minutes; thus, in one case, the potential dropped gradually from 1.92 volts to 1.87 volts in thirty-eight minutes. Other complex amalgams have been studied, but none is as stable as tetramethyl ammonium amalgam. We suggest that metallic properties depend on the ability of the atom *or radicle* to lose one or more electrons. Metals may be compounds.

The Zinc Antimony Alloys: B. E. Curry.

The equilibrium diagram is presented showing the phases to be pure zinc, pure antimony, the compound ZnSb, and three series of solid solutions, α, β and γ.

Corrosion of Cadmium in Nitrate Solutions: G. R. White.

When cadmium is made anode in 75 per cent. sodium nitrate solution and a current of .4 ampere is passed through the corrosion is greater than theoretical. This difference is affected by current density and temperature.

The corrosion produced appeared as a white or grayish precipitate and did not contain metallic cadmium. The solution contained nitrites in large quantities after corrosion began. Analysis indicates the formation of cadmium hydroxid. The formation of nitrites may produce the high corrosion efficiency by the formation of cadmous compounds.

Some Organic Compounds of Beryllium: Chas. L. Parsons and Geo. J. Sargent.

During the last two years Glassman, publishing in the *Berichte*, and Tanatar, publishing in the *Journal of the Russian Physical and Chemical Society*, have claimed to prepare several beryllium salts of organic acids, for which they have claimed definiteness of composition. Glassman announces the dichloracetate, cyanacetate, monochloracetate, monobromacetate, monobrompropionate, lactate, glycolate, trichloracetate, ethylglycolate, phenylglycolate, chloropropionate and salicylate, to which he gives the typical formulas of either $Be_4O(A)_6$ or $Be_2O(A)_2$. Tanatar claims to have prepared the crotonate, isocrotonate, lævulinate and succinate, to which he gives the typical formulas $Be_4O(A)_6$ and the tricarballylate, citrate, salicylate, phthalate, lactate and benzoate, to which he gives somewhat more complex formulas.

These salts were all produced by saturating the aqueous solution of the acid with basic beryllium carbonate and evaporating to dryness, and the formulas were for the main part derived from the simple calculation on the beryllium oxide found, adding water of crystallization when necessary. In one or two instances the lowering of the freezing point in organic solvents was obtained as additional evidence of constitution. For the main part the residues were glassy, gummy masses, although in one or two instances they were thought to be crystalline.

These results were so at variance with previous researches on beryllium compounds where it had been shown that it was next to impossible to obtain definite compounds of such weak acids from aqueous solution that we undertook a careful research in regard to the definiteness of composition of some of these salts and examined more especially the succinate, lactate, glycolate, salicylate, citrate, phthalate, benzoate, picrate and monochloracetate. As a result it was proved without any question that the residues obtained were all of a glassy, glutinous nature and that their composition varied through wide limits according to the extent of the saturation. As one of us has already shown that the salts of beryl-

lium dissolve varying quantities of beryllium carbonate or hydroxide according to the concentration of the acid solutions used, and, further, that the freezing point of solutions containing this material was raised rather than lowered by increasing the quantity of the beryllium hydroxide dissolved, this evidence of constitution is overthrown.

Quite different from these weak acids, however, was the case with the comparatively strong trichloracetate $Be(CCl_3CO_2)_2 2H_2O$, which does yield a perfectly definite compound if prepared, as salts of beryllium of this kind must always be prepared, from solution containing an excess of the acid. This salt was made in several different ways and repeatedly recrystallized, and was shown to have perfect definiteness of composition, losing its two molecules of water of crystallization at 100°. We have no hesitancy in saying that none of the above mentioned acids can be prepared as definite compounds from water solution with the exception of the trichloracetate, and it is probable that this will be found to be true of most acids having a dissociation constant lower than that of trichloracetic acid. Attempts were also made to make definite salts of these acids from solution in organic solvents, but without success.

The Bromates of the Rare Earths—Part II., The Bromates of the Cerium Group and Yttrium: C. JAMES and W. F. LANGELIER.

The pure bromates of lanthanum, cerium, praseodymium, neodymium, samarium and yttrium were prepared from the pure sulphates by treating them with barium bromate and their properties studied.

All of these bromates were found to have the formula $R_2(BrO_3)_6 18H_2O$ and when heated to 100° they were all converted into a hydrate containing $4H_2O$ with the exception of yttrium bromate, whose hydrate at 100° contains $6H_2O$ and cerous bromate. They all lost their water of crystallization and became anhydrous at 150° and at a higher temperature they were all decomposed with evolution of both light and heat. Indeed, praseodymium bromate loses all of its water of crystallization at 130° and decomposes at 150°, while cerous bromate decomposes at a much lower temperature, approximating 50°. In water solution cerous bromate gradually evolves oxygen, precipitating an insoluble residue and leaving behind in solution probably ceric bromate, which, however, was not isolated on account of the ease of its decomposition, its strong aqueous solution being indeed so active an oxidizing agent that it causes explosive combustion of organic material such as filter paper or cotton when poured upon it.

The general results may be summarized as follows:

	Melting Point	100 Parts H_2O Dissolved
$La_2(BrO_3)_6.18H_2O$	37.5	416
$Ce_2(BrO_3)_6.18H_2O$	49	—
$Pr_2(BrO_3)_6.18H_2O$	56.5	190
$Nd_2(BrO_3)_6.18H_2O$	66.7	146
$Sm_2(BrO_3)_6.18H_2O$	75	114
$Yt_2(BrO_3)_6.18H_2O$	74	168

Some Physical Properties of Sulphur Trioxide: D. M. LICHTY, University of Michigan.

Sulphur trioxide, purified by repeated distillation of the commercial article over pure phosphorus pentoxide in a vessel[1] exhausted to 50 mm. or less, melts sharply at 16.8° (Weber 14.8°), boils at a temperature not exceeding 44.8° under 760 mm. pressure, and seems to be purer than that prepared by Weber.[2] If kept from contact with moisture, it retains its sharp melting point and at room temperature is in appearance a very transparent mobile liquid which really consists of a liquid variety, containing, dissolved in it, and presumably in equilibrium with it, a considerable quantity of a solid variety. The depression of the freezing point of phosphorus oxychloride, caused by this mixture, leads to the formula SO_3.[3] The coefficient of expansion is very high, agreeing essentially with that found by Schulz-Sellak[4] and by Schenck.[5] If exposed to a relatively small amount of moist air, the liquid solidifies more or less completely at room temperature. The depression of the freezing point of phosphorus oxychloride, produced by a completely solidified sample, also leads to the formula SO_3. The ordinary asbestos-like needles seem to be a polymer having the formula S_2O_6.[6]

The Modern Manufacture of White Lead: J. S. STANDT.

The paper gives the description and chemistry of the various processes of white-lead manufacture in use, including the Old Dutch, English, French, Milner's, etc. It enumerates some of the more important English and American patents.

[1] *J. Am. Chem. Soc.*, 30, 1836.
[2] *Pogg. Ann.*, 159, 313 (1876).
[3] Oddo, *Gazz. chim. ital.*, 31, II., 158 (1901).
[4] *Ben.*, 3, 215.
[5] *Ann.*, 316, 1 (1901).
[6] Oddo, *loc. cit.*

The paper deals largely with the description and chemistry of the Carter process of white-lead manufacture. By this "quick process" is produced a white lead having the requisite properties of a good paint.

The following papers were reported by title:

The Physical Chemistry of Certain Arrowheads: W. R. Whitney.

The Electrical Conductivity of Concentrated Solutions: E. C. Franklin.

Rapid Electro-analysis with Graphite Cathode Dish: J. W. Turrentine.

Effects of Surfaces on Reactions: F. K. Cameron.

Behavior of the Higher Hydronitrides in Liquid Ammonia: A. W. Browne and T. W. B. Welsh.

Valence—What is it? C. H. Herty.

The Effect of Salts on the Toxicity of Phenol Solutions: W. Lash Miller.

The Formation of Carbon Dioxide in Solutions of Thorium Nitrate: R. B. Moore.

Observations on the Use of the Auxiliary Electrode in Rapid Electrolytic Analysis: E. P. Schoch, Ethel Sykes, D. J. Brown and A. G. Koenig.

The Atomic Weight of Silver: T. W. Richards and H. H. Willard.

Basic Magnesium Chlorides: W. O. Robinson and W. H. Waggaman.

The Relation between Fluidity and Vapor-pressure: E. C. Bingham.

The Tensile Strength of the Zinc-aluminum Alloys: V. J. Skillman.

The Reduction of Nitrobenzene by Iron: R. C. Snowdon.

The Behavior of the Iron Anode in Various Electrolytes: E. P. Schoch and C. P. Randolph.

The Chemical Properties of the Radioactive Products of Thorium: H. N. McCoy.

A New Apparatus for Regulating the Supply of Heating Mediums for Scientific and Similar Apparatus: Geo. E. Edelen.

The Size of Pores in Membranes and Osmotic Effects: S. Lawrence Bigelow.

Lead Silicates: H. C. Cooper.

The Melting Point and Volatility of Chromium: W. C. Arsem and Harold Rush.

Electric Vacuum Furnace Installations in the Research Laboratory of the General Electric Company: W. C. Arsem.

The Salts of Dichlor-tungstic Acid: W. C. Arsem.

Oxalo-molybdic Acid and its Salts: W. C. Arsem.

Molecular Attraction: J. E. Mills.

The Internal Heat of Vaporization: J. E. Mills.

On the Kinetics of Certain Inorganic Reactions in Heterogeneous Media: M. A. Rosanoff and B. S. Merigold.

Division of Organic Chemists

R. S. Curtiss, chairman

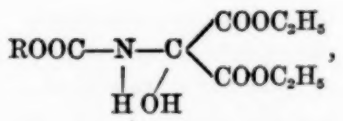
Ralph H. McKee, secretary

Condensations in the Mesoxalic Ester Series: R. S. Curtiss.

Condensations with oxomalonic esters and some alcohols, amines, acidamids and haloid acids have been tried with a view of forming intermediate addition products on the carbonyl group of the ester, also of studying the relative effect of groups of different degrees of positivity or negativity upon the reactivity of the ammonia radical with the carbonyl group of the ester, and the stability of the resulting addition products. Comparative studies of these reactions with methyl and ethyl oxomalonate have been made. Perfectly pure ethyl oxomalonate has been made by distilling the hydrate over P_2O_5.

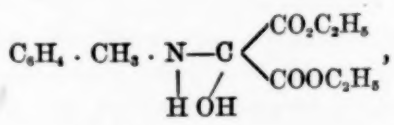
Ethyl, methyl, benzyl and propyl alcohols react with ethyl oxomalonate—with the characteristic loss of color of the keto ester, and formation of thick colorless syrups—which partially dissociate on being heated into the original constituents, and which are changed by water into alcohol and the dihydroxyester.

Ethylurethane forms a crystalline addition product,

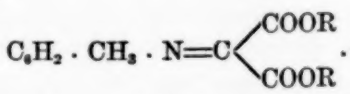


which is transformed into a faintly colored oil by P_2O_5. Urea reacts to give a colorless crystalline product also.

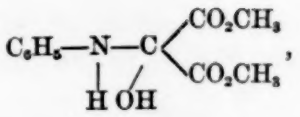
Aniline (1 mol.) reacts with ethyl oxomalonate to give ethyl dianilinomalonate. Attempts to get the intermediate addition body failed. However, *p*-toluidine gives a white crystalline addition compound,



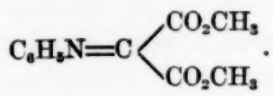
which easily loses H_2O over sulphuric acid—yielding an oil—



This is in analogy with the action of aniline in methyl oxomalonate, which gives a colorless crystal body.



which by P_2O_5 is converted into an oil,



This methyl phenyliminomalonate is a remarkable reaction substance, an analogue of phenyl isocyanate. The reactions of this, and analogous compounds in this series, are being investigated.

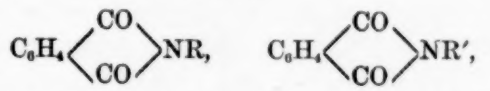
HCl and HBr appear to add on the carbonyl group of ethyl oxomalonate, but owing to the low temperature (below —30°) at which the crystalline products dissociate we have not been able to get true analytical figures as we have done with methyl oxomalonate and these acids, where one molecule of the acid is added to the keto ester.

Hydrogen Polysulphide as a Reducing Agent: ALFRED TINGLE.

The hydrogen polysulphide, or mixture of polysulphides, prepared by boiling lime with flowers of sulphur and acidifying the resulting cooled, clear liquid, possesses the following advantages as a reducing agent. It is neutral; it is readily soluble in ionizing media, such as water or alcohol, and also in non-ionizing liquids, such as carbon disulphide. The exact concentration of these solutions may be determined easily and with a high degree of accuracy by titration with iodine solution. Preliminary experiments on the reducing power of the polysulphide show that its reaction with nitrobenzene is vigorous, but rather complicated. Picric acid is easily reduced, at the ordinary temperature, to picramic acid. The work is being continued at the McMaster University.

Intramolecular Rearrangement of Phthalamidic Acids: J. BISHOP TINGLE and B. F. PARLETT BRENTON.

In continuation of the work of Bishop Tingle and Rolker[1] on the interaction of amines and phthalamidic acids, $RR'NCOC_6H_4CO_2H$, the authors have studied the action of pyridine, aniline and β-naphthylamine, respectively, on phthaldiphenylamidic, phthal-*p*-chlorphenylamidic and phthaldiisobutylamidic acids. An investigation has been made of the behavior of benzylamine with phthal-*p*-tolylamidic and with phthal-*m*-nitrophenylamidic acids; this latter acid has also been caused to react with the following additional bases: alcoholic ammonia, diisoamylamine, benzylethylamine, dibenzylamine, isoamylamine, butylamine, isobutylamine and tribenzylamine. The results are in general accord with the conclusions reached by Bishop Tingle and Rolker. Considering, for the sake of illustration, primary amines, RNH_2, and monosubstituted phthalamidic acids, $RNHCOC_6H_4CO_2H$, one or more of the following four products are formed:



$RNHCOC_6H_4CONHR'$ and $C_6H_4(CONHR)_2$.

[1] *J. Am. Chem. Soc.*, 30, 1882.

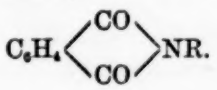
Action of Amines on Dicarboxylic Acids of the Aliphatic and Aromatic Series: J. BISHOP TINGLE and B. F. PARLETT BRENTON.

The work of Bishop Tingle with Messrs. Rolker and Brenton (cf. preceding abstract) has shown that, under certain conditions, the chief product of the interaction of amines, RNH_2, on phthalamidic acids, $R'NHCOC_6H_4CO_2H$, is an imide,

Occasionally, however, the unsymmetrical or the symmetrical diamide, $R'NHCOC_6H_4CONHR$, or $C_6H_4(CONHR')_2$, is also formed. Bishop Tingle and Bates (cf. following abstract) have found that, under suitable conditions, the diamide is the chief material from amines and dicarboxylic acids of the aliphatic series. Few if any of the unsymmetrical diamides are known. A study has been made, therefore, of the action of a variety of amines on phthalic acid, in the hope that, by selection of suitable experimental conditions and also of the groups R and R″ in the amine, RR″NH (R and R″ = hydrogen, alkyl, or aryl), a method might be developed for the preparation of unsymmetrical amides. The authors have obtained several of the compounds in question and have prepared, in the course of the work, a considerable number of new substances of other types which will be described in due course.

Aliphatic Phenylamidic (Anilic) Acids: J. BISHOP TINGLE and S. J. BATES.

It has been shown by Bishop Tingle and his co-workers that certain amidic acids of the phthalic series, $RNHCOC_6H_4CO_2H$, form salts with amines and that these salts quickly undergo condensation to the imide,



Similar experiments have been carried out with the following aliphatic amidic acids: furmaranilic, maleanilic, malanilic, tartranilic and oxanilic, but in no case could a similar transformation into the substituted imide be detected. Analogous results were obtained by Bishop Tingle and Lovelace for succinanilic acid.[8] It appears, therefore, that this capacity for intramolecular condensation is a specific property of aromatic acids. The chief products from the aliphatic acids appear to be symmetrical or unsymmetrical diamides, RNHCO ··· CONHR, and RNHCO ··· CONHR′, respectively. In the course of the work there has been prepared a considerable number of hitherto unknown salts and other derivatives of amines and of the acids mentioned above. These will be described later. In the case of the unsaturated acids the amines form additive compounds with great ease. The addition of the elements of the amine, H and NHR, takes place at the position of the double linkage. Experiments have also been made on the interaction of aniline and some acids of the itaconic series.

Action of Nitranilines on Certain Organic Acids: J. Bishop Tingle and C. E. Burke.

In connection with the investigations of Bishop Tingle and Blanck on the nitration of *N*-acyl derivatives of aniline,[9] a study is being made of the action of the isomeric nitranilines on certain aliphatic and aromatic carboxylic acids. In addition to a number of salts which have not hitherto been described, the authors have prepared several new isomeric nitrophenylamidic (nitranilic) acids, $O_2NC_6H_4NHCO \cdots CO_2H$, nitrophenylamides (nitranilides), $O_2NC_6H_4NHCO \cdots CONHC_6H_4NO_2$ and $O_2NC_6H_4NHCO \cdots CONHR$, and nitrophenylimides (nitranils),

$$\begin{matrix} -CO \\ -CO \end{matrix} \Big\rangle NC_6H_4NO_2.$$

The results of the investigation promise to furnish some interesting data concerning the relationship between the structure of the nitranilines and the mode of their reactivity in this connection.

The following papers were reported by title:

A Study of Hydrazino Compounds: Wm. McPherson and Howard J. Lucas.

A General Method for Preparing the Pure Sulphates of Hydroxyazo Compounds: William McPherson and Cecil Boord.

[8] *Am. Chem. J.*, 38, 642.

[9] *J. Amer. Chem. Soc.*, 30, 1395, 1587.

Preparation and Oxidation of m-Nitrobenzoylformaldehyde: Wm. L. Evans and E. J. Witzemann.

On Some Amino and Nitroamino Derivatives of Benzoic, Metatoluic and Metaphthalic Acids: M. T. Bogert and A. H. Kropff.

On 2-methyl-3-amino-4-quinazolone and Certain of its Derivatives: M. T. Bogert and R. A. Gortner.

On Oxalylanthranilic Compounds and Some Quinazolines Derived therefrom: M. T. Bogert and R. A. Gortner.

Stereoisomeric Nitrogen Derivatives—Chlorimidoketones: Julius Stieglitz.

The Isolation of Some Further Organic Substances from Soil Humus: (1) *Alpha-hydroxystearic Acid,* (2) *Paraffinic Acid,* (3) *Liquid Fatty Acids:* Oswald Schreiner and Edmund C. Shorey.

The Action of Molecular Silver and Silver Sulphate on Ortho-brominated Triphenylcarbinolchlorides: M. Gomberg and L. L. Van Slyke.

The Constitution of the Double Salts of Triphenylcarbinolhalides with Metal Halides: M. Gomberg and L. P. Kyriakides.

Glycogen Content of Beef Flesh: P. F. Trowbridge and C. K. Francis.

The Barium Salts of Phthalic Acid: F. B. Allan.

A Third Methyl Ester of Phthalic Acid: F. B. Allan and C. G. Allin.

The Preparation and Properties of Phthalyl Cyanide: F. B. Allan and C. H. Robinson.

The Rearrangement of Tautomeric Salts: Sidney Niedlinger.

Researches on Quinazolines (24th paper). On *6-methyl-7-aminoquinazolones, 7-nitroquinazolone-6 carboxylic acids, and 1, 3, 7, 9-naphthotetrazines:* M. T. Bogert and A. H. Kropff.

Simple χ-β Diglycerides: R. R. Renshaw.

Choline, I.: R. R. Renshaw.

Bactericidal Properties of Lecithin: R. R. Renshaw and K. N. Atkins.

Investigation of the Fruit of the Rose: Nicholas Knight and Layton Gouldin.

Molecular Rearrangements in the Camphor Series: W. A. Noyes, E. Gorsline and Luther Knight.

Some Effects of Solvents containing Hydroxy Groups on True Nitroso Compounds: Edward Kremers.

A New Synthesis of Alkyl Halides: W. C. Arsem.

The Octanes: Nathan Clarke.

B. E. Curry,
Press Secretary